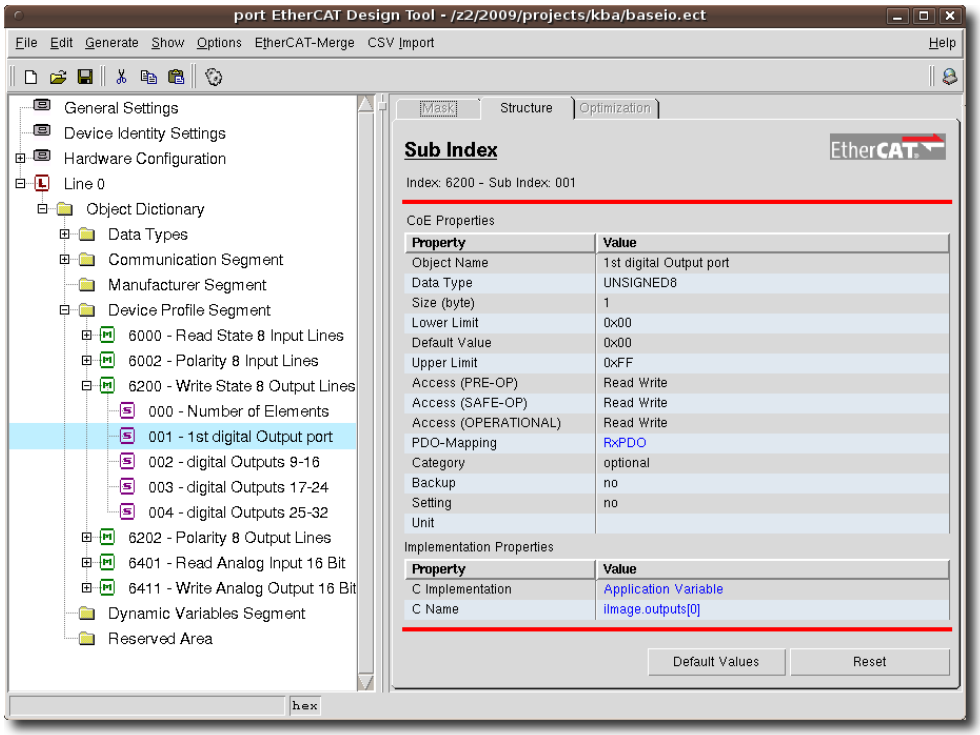
EtherCAT® Design Tool

User Manual



© *port* GmbH, Halle 2013/02/05; EtherCAT® Design Tool Version 1.1.0

Disclaimer
All rights reserved

The programs, boards and documentations supplied by *port* GmbH are created with due diligence, checked carefully and tested on several applications.

Nevertheless, *port* GmbH can not take over no guarantee and no assume del credere liability that the program, the hardware board and the documentation are error-free respective are suitable to serve the special purpose.

In particular performance characteristics and technical data given in this document may not be constituted to be guaranteed product features in any legal sense.

For consequential damages, which are emerged on the strength of use the program and the hardware boards therefore, every legal responsibility or liability is excluded.

port has the right to modify the products described or their documentation at any time without prior warning, as long as these changes are made for reasons of reliability or technical improvement.

All rights of this documentation lie with *port.* The transfer of rights to third parties or duplication of this document in any form, whole or in part, is subject to written approval by *port.* Copies of this document may however be made exclusively for the use of the user and his engineers. The user is thereby responsible that third parties do not obtain access to these copies.

The soft- and hardware designations used are mostly registered and are subject to copyright.

CANopen®
is registered trademark, licensed by CiA - CAN in Automation e.V., Germany.

EtherCAT®
is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

We are thankful for hints of possible errors and may ask around for an information.

We will go all the way to verify such hints fastest

Copyright

© 2013 *port* GmbH
Regensburger Straße 7
D-06132 Halle
Tel. +49 345 - 777 55 0
Fax. +49 345 - 777 55 20
E-Mail service@port.de
Internet http://www.port.de

Table of Contents

1. Introduction 7
1.1. Product Overview 7
1.2. Product Delivery 7
1.3. System requirements 7
1.4. Installation 7
1.5. Support by *port* 8
2. Usage of the EtherCAT® Design Tool 9
2.1. Main menu 9
2.2. Object tree 9
2.2.1. Hardware configurations 10
2.2.2. Object dictionary 10
2.3. Action menus 10
2.4. Forms 11
2.4.1. General Settings 12
2.4.2. General EDS/ESI/XDD settings 12
2.4.3. Advanced configuration 12
2.4.4. Hardware configurations 12
2.4.5. Mask view 12
2.4.6. Structure view 12
2.5. Program control 15
3. File structure 17
3.1. Project structure 17
3.1.1. Project file 17
3.1.2. Generated files 17
3.2. Profile files 17
4. Project editing 19
4.1. Beginning a project 19

4.2. Hardware configuration 19
4.3. Application variables 19
4.3.1. Parameterization of application variables 20
4.3.2. C Implementation 20
4.4. Communication variables 22
4.4.1. Parameterization 22
4.5. Generation of source code 22
4.6. %-Variables 22
4.7. {}-Expressions 23
4.8. Post-Generation command 23
5. Generation of user-specific object descriptions 25
5.1. Format descriptors 25
5.2. Example for HTML documentation 26
5.3. Example for Tcl scripts 27
6. EtherCAT-Merge PlugIn 29
6.1. Project View 29
6.2. Detail View 30
7. CSV-Import PlugIn 31
7.1. Usage 31
7.2. Examples 32
8. Different versions 33
8.1. Standard version 33
8.2. Light version 33
8.2.1. Limitations 33
8.2.2. Usage 33

1. Introduction

1.1. Product Overview

The EtherCAT® Design Tool of *port* is a software tool for the development of EtherCAT® applications (devices). It manages device data bases from which an Object Dictionary, configuration and initialization files in C-code, an Electronic Data Sheet, a XML description and a HTML-documentation are created automatically. Furthermore the driver packages can be configured by the EtherCAT® Design Tool and several hardware configurations can be managed within one project.
With the EtherCAT® Design Tool an instrument is available which frees the developer of error-prone activities repeating itself. It ensures consistency of implemented functionality, , Electronic Data Sheet (ESI) and device documentation. In the scope of delivery a data base with the EtherCAT® communication profiles are contained. Profile databases are optionally available for various device profiles, for example digital I/O devices according to CiA-401 or drives according to CiA-402.
The created Object Dictionary supports numerous options of the EtherCAT® library from *port*. A tree representation of all implemented parameters and data eases the maintenance of device software. With the EtherCAT® Design Tool the beginning with the EtherCAT® protocol is less difficult and the development of a device is accelerated.

1.2. Product Delivery

The scope of delivery of the EtherCAT® Design Tool:

- User Manual
- software for EtherCAT® Design Tool
- data bases for device profiles (optional)

All components are available for download.

1.3. System requirements

The EtherCAT® Design Tool runs on PC's with Microsoft Windows™ or Linux.

Operating System:	Windows 2000, Windows XP, Vista, Windows 7, Linux
Processor:	Pentium IV or later
RAM:	512 MByte
Hard-disk Space:	45 MByte

1.4. Installation

The installation is controlled by menus. For this purpose, unpack the zip-file and start **setup.exe** on Windows™ resp. setup.sh on Linux. After this installation you will find the following directory structure.

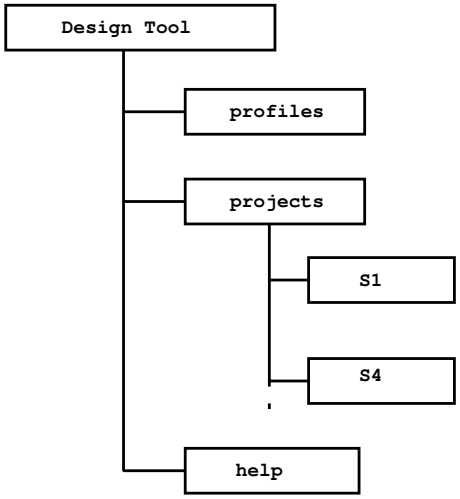


Figure 1, Directory structure of the EtherCAT® Design Tool

The directory **projects** contains delivered example projects. For each project a separate directory is recommended. The data bases are in the directory **profiles** for the communication profiles and the EtherCAT® device profiles. In this directory own profiles can also be generated. The directory **help** serves internal purposes.

After an installation on a Windows™ system the EtherCAT® Design Tool can be started by the icon on the desktop or via the start menu.

1.5. Support by *port*

The senior engineers at port support the user by a telephone hot-line and by training courses. Additionally the user can have consultations in the whole field of EtherCAT® e.g. network planning, network configuration, message distribution, selection of devices and EtherCAT® Profile implementations.

Please ask at our email address

E-mail: **service@port.de**

phone: **+49 345 777 55 - 0**

Fax: **+49 345 777 55 - 20**

The engineers at *port* react as soon as possible to your message.

2. Usage of the EtherCAT® Design Tool

The EtherCAT® Design Tool is controlled via menus, toolbars, treeviews and masks.

2.1. Main menu

The Main menu consists of the following entries:

File — Via the menu option *File* the projects are created, loaded and closed. Further, in this menu the program can be terminated.

Edit — The menu options below *Edit* are meant to copy, cut or paste objects in the object dictionary.

Generate — By selecting the menu option *Generate all Files* within the menu *Generate* the Object Dictionary , electronic device description and the configuration file **ecat_conf.h** is generated. If *Generate Documentation* is selected, the documentation in HTML and as plain text will be generated.

Show — Via the menu option *Show* all the generated files can be viewed. The HTML Documentation is displayed with the standard browser.

Options — The *Options* menu organizes the options for the following:

- Generation of electronic device descriptions
- Default selection of mask or structure view for objects.
- Object description structures
- object.c generation
- Font configuration

View options are saved user-specific in the registry (or in a .rc file under Linux) and generation options are saved project-specific in the project file.

Help — In the *Help* menu the help for the current mask or the manual can be viewed. It is shown in the standard browser.

Figure 2, Toolbar

The toolbar below the menu provides a fast access to the following functions: new project, open, save, cut, copy, paste, generate, add new service objects and query new releases.

2.2. Object tree

The object tree is central administrative element for all EtherCAT® entities as well as all further device parameters and for the hardware configurations. It consists of branches for the global device parameters, branches for the hardware configurations, and the branch

for the supported EtherCAT® line. The global ESI/EDS resp. XDD parameters are parameters such as manufacturer name and product designation which are identical for every EtherCAT® line.

The individual line entries are split into:

- Device Identity Settings
- Object dictionary

2.2.1. Hardware configurations

The EtherCAT® Design Tool can manage several hardware configurations.
A hardware configuration consists of:

- CPU Settings
  Choice and configuration of the CPU or the operating system
- Compiler Settings
  Choice and configuration of the used compiler
- EEPROM Settings
  Configuration of EtherCAT Slave Controllers (ESC)

By setting the hardware configuration, defines in the file **ecat_conf.h** are set that configure the Driver Package.

2.2.2. Object dictionary

The object dictionary is divided into different branches for the separate segments.

- data types (Indices $0001_h - 025F_h$)
- communication data (Indices $1000_h - 1FFF_h$)
- manufacturer specific data (Indices $2000_h - 5FFF_h$)
- standardized device profile segment data (Indices $6000_h - 9FFF_h$ in blocks of 800_h)
- reserved area $A000_h - FFFF_h$

The division of the area for standardized device profiles into blocks of 800_h was carried out under special regard to the multi device profile. Operations, as doubling identical segments, can be implemented simply by the representation of every device profile as a separate segment.

The individual branches of the object dictionary contain the EtherCAT® objects. These entities are in turn divided into their sub-index elements.

On activation of the individual components in the tree, action menus are displayed in the right frame. e.g. for the data import or the accordant object forms.

2.3. Action menus

The action menus differ for every branch of the object tree. Menus are available for:

- operations for the hardware settings
- operations referring to one EtherCAT® line

- operations referring to the object dictionary
- operations referring to communication parameters
- operations referring to manufacturer specific parameters
- operations referring to device profile parameters

Hardware configuration can be:

- added,
- copied,
- deleted,
- imported and exported.

For the object dictionary the following actions are available:

- data import from profile files
- data export to profile files

One can execute for the segment with communication parameters:

- data import from files (profile or EDS/XDD)
- data export to profile files
- creating of new objects (indices)
- creating of new communication service objects

The vendor-specific segment has action buttons for:

- data import from files (profile or EDS/XDD)
- data export to profile files
- creating new objects (indices)

For the device profile segment the following actions are possible:

- data import from files (profile or EDS/XDD)
- data export to profile files
- creating new objects (indices)
- creating of a sub segment

For sub segments the following actions are available:

- data import from files (profile or EDS/XDD)
- data export to profile files
- creating new objects (indices)
- configuration of the sub segment

2.4. Forms

Forms and input masks simplify the data input. Additionally to the following documentation there is a online help for each mask available about <F1>.

2.4.1. General Settings

The general settings are meant to define global device settings. With these settings the EtherCAT® library is configured with the help of the file **ecat_conf.h.**

2.4.2. General EDS/ESI/XDD settings

The global EDS/ESI/XDD form is used for processing all device global entities, that are device, manufacturer and ordering data.

2.4.3. Advanced configuration

This mask provides access to special user defines in the configuration file **ecat_conf.h**. This file is included in all EtherCAT®-files and should be included in every EtherCAT®-related project file. So compiler directives changed here, will affect the whole project.
Please enter valid C code like e.g.

```
#define CONFIG_BIG_RAM_VERSION 1
/* undefine printf */
#define PRINTF
```

Be carefully with these settings.

2.4.4. Hardware configurations

A hardware configuration can be renamed, duplicated, deleted, imported and exported by its action menu. The active configuration is marked with a pair of asterisks (*) in the project tree.

The parameters of the sub sections are explained in the context help for each mask.

2.4.5. Mask view

These forms are a wizard for the communication parameters. In this way, the input of the parameters is facilitated since the bit values coded are converted into text outputs. Contiguous entities are also parameterized transparently for the operator. Please regard that the mask view is only available for some objects.

2.4.6. Structure view

The structure view is the universal editor with that all entity parameters can be changed. It is distinguished into a view for the index parameters and one for the sub-index parameters.

Name	Description
Index	Number of index (hexadecimal)
Data Type	data type according to EtherCAT®
Object Code	Kind of object according to EtherCAT® specification: allowed values: Variable, Array, Record, Domain
Object name	name of the object in XDD/EDS/ESI file
Description	description of the object for the documentation and for the parameter description in XDD files

Table 1, Elements of the structure view for indices

The data type and the object code are fixed for communication objects in the object range 1000_h to $1FFF_h$ to be compliant to the specification.

Name	Description	Scope			
		Lib	EDS	ESI	Doc
Index	Number of index (hexadecimal)	x	x	x	x
Sub-Index	number of sub-index (decimal)	x	x	x	x
PDO-Mapping	if selected, the object can be mapped to a PDO	x	x	x	x
Object Name	object name for sub-index		x	x	x
Unit	measurement unit of the object				x
Access	access permissions seen from EtherCAT® (according to device type)	x	x	x	x
Data Type	type of object	x	x	x	x
Size	size of object in Bytes	x		x	
Value	defaultvalue of the variable	x	x	x	x
Lower Limit	lower limit for numerical values	x	x	x	x
Upper Limit	upper limit for numerical values	x	x	x	x
Backup	Backup flag of the object			x	x
Setting	Setting flag of the object			x	x
C Implementation	Implementation type of the object: Managed Constant, Managed Variable, Application Variable, Application Array.	x			
C Name	Variable name of the object (if applicable)	x			

Table 2, Elements of the structure view for Sub indices

Within the *Object Name* entries internal %-variables can be used. They will be replaced with the their current value at generation. E.g. %s stores the value of the current sub-index and an XDD name like "Output %s" will be replaced with "Output 0", "Output 1" ... or "Output 254". With these substitutions it becomes much more easier to copy or duplicate objects. All %-variables are described in section *%-variables* in chapter 4.7.

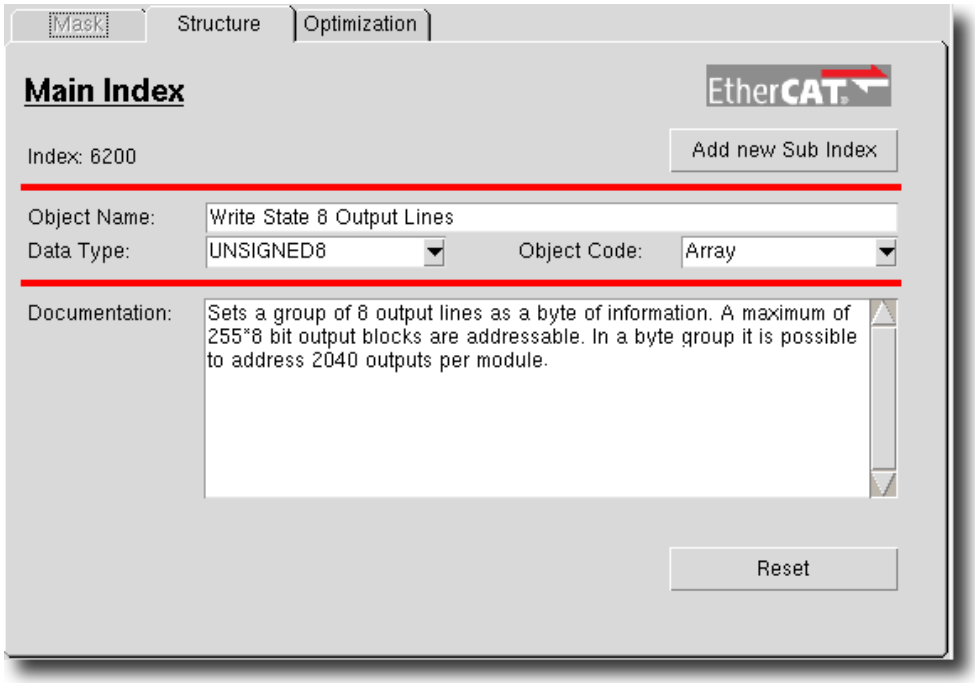


Figure 4, structure view of an object

2.5. Program control

The operation of the entire program is done mostly with the mouse. Changed values are taken over only at leaving of the mask. E.g. continuous actions such as computation of new sizes during type variation.

Modifications at a mask can be reset before the mask has been left by pressing the button "Reset". If default values are available for a mask, these values can be loaded by the button "Default".

3. File structure

3.1. Project structure

3.1.1. Project file

All data of an project are stored in the project file. Nevertheless it is useful to have a directory for every project, because the generated files will be stored in the project directory.

The directory 'projects' under the program directory contains some example projects.

3.1.2. Generated files

The generated files are described in table 3.

File	Description
ec_od.c	Implementation of the object dictionary (C code)
ec_objects.h	generated application variables (C code)
ec_objects.c	generated application variables (C code)
ecat_conf.h	configuration file for the library (C code)
ec_init.c	initialization file for the library (C code)
<edsFileName>.eds	generated CANopen EDS file
<edsFileName>.xml	generated XML file (ESI)
<projectName>_docu.txt	documentation as text for implemented objects
<projectName>.html	documentation in html for implemented objects
<projectName>_eeprom.bin	EtherCAT EEPROM data in binary file
generate.err	information file that contains error and warning messages

Table 3, Generated files

After generation the files, the object dictionary for the EtherCAT® source library and a documentation are available. If errors occurred, the files have not been generated and the errors are listed in **generate.err**

3.2. Profile files

Profile files contain parts of an object dictionary with the objects and their attributes. The EtherCAT® Design Tool is delivered with a profile, that contains all communication objects according to the communication profiles. If communication objects are set up with the EtherCAT® Design Tool, the entries will be loaded automatically from this profile. Additionally to the communication object data base, profile files for other EtherCAT® device profiles are available from *port*. By means of these profiles standard

applications can be implemented in shortest time.

For demonstration purpose some device profile data bases are delivered with the EtherCAT® Design Tool. Objects from such a device profile data base can be imported, but without a valid license for this data base the output cannot be created. To order a license for a device profile please contact service@port.de ⟨service@port.de⟩.

If parts of a project are to be used in later projects, the data can be exported into a separate file.

4. Project editing

This chapter describes the working flow for creating and editing projects. The order of the flow is not mandatory, but very useful. Basic parameter like the number of EtherCAT® lines and the kind of the device (Slave or Master) should be clear at the beginning of the development. The necessary steps are the following:

- configuration of global parameter
- configuration of global ESI resp. EDS parameter
- configuration of the hardware settings
- configuration of standard and additional settings
- definition of application variables
- parameterization of application variables
- definition of communication variables
- parameterization of communication variables
- optimization of each object if needed
- generation of outputs

4.1. Beginning a project

A project is created by the menu *File* → *New Project*.
Existing projects are opened by the button *Open Project* or the menu *File*.
Each EtherCAT® line can be preset with data from a profile or an EDS file.

4.2. Hardware configuration

At first the target hardware has to be configured. The most important decision is to choose a CPU resp. an operating system.
These configuration files (`conf_xxxx.h`) can be imported via "Import Configuration".

If the CPU is set, the other CPU settings are set to CPU-specific default values. These default values are suitable in the majority of cases. At *Compiler Settings* the used compiler can be selected.

If the application shall be used on different hardware plattforms, more than one hardware configuration can be created. If no configuration is marked as active, the define `CONFIG_USE_TARGET_x` must be set to 1 in the makefile or in the compiler.

4.3. Application variables

Definition of application variables is the creation of objects with indices in the range of $2000_h - 5FFF_h$ for manufacturer specific profiles or in the range of $6000_h - 9FFF_h$ for standardized device profile objects. There are two ways for the definition:

- loading from a profile
- creation by hand

The first way is easier. Certain objects can be selected by means of their index from an profile. Databases for the standardized EtherCAT® device profiles are available from *port*. If a database doesn't exist yet, all entries can be created by hand. It is distinguished in parameter for the index and for parameter describing the sub-index.
The index parameter defines the structure of the variable. That means their type, kind (Variable, Array, Record, Domain), the number of sub-indices , the C implementation type and a variable name (if applicable) and an object name. Furthermore the variable can be commented. This comment will be a part of the documentation for this object. The parameters for sub-indices contain an object name for record or array members, size and type and access permissions. For each a unit can be assigned. If application-specific data types for records are used, they have to be defined in the data type section of the object directory in advance of their usage.

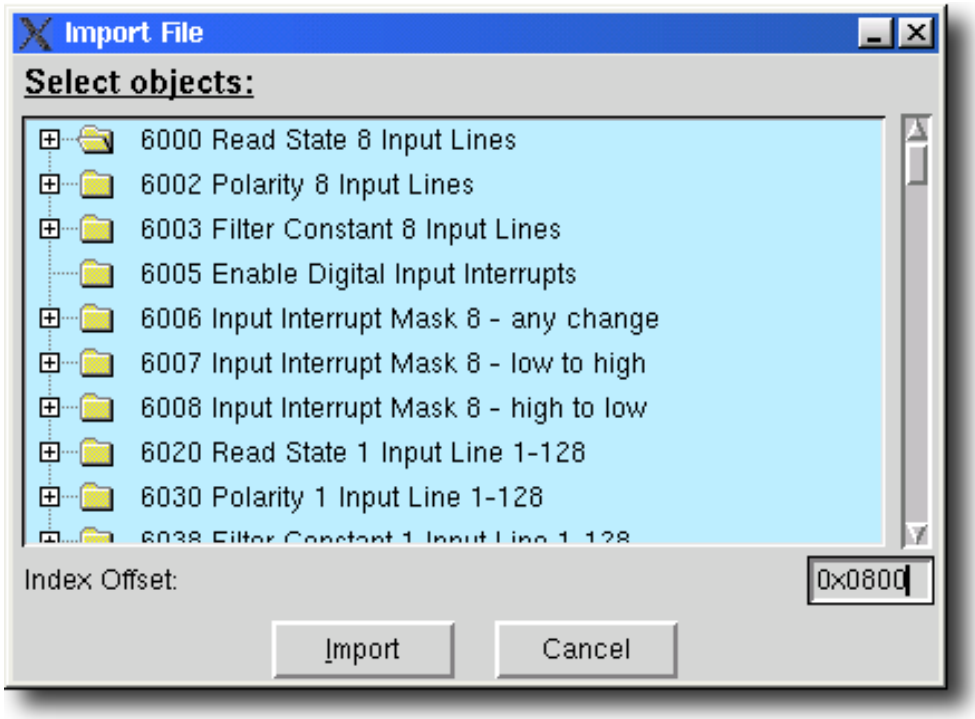

Import File
Select objects:
6000 Read State 8 Input Lines
6002 Polarity 8 Input Lines
6003 Filter Constant 8 Input Lines
6005 Enable Digital Input Interrupts
6006 Input Interrupt Mask 8 - any change
6007 Input Interrupt Mask 8 - low to high
6008 Input Interrupt Mask 8 - high to low
6020 Read State 1 Input Line 1-128
6030 Polarity 1 Input Line 1-128
Index Offset:
0x0800
Import
Cancel

Figure 7, import mask for profiles

4.3.1. Parameterization of application variables

The parameterization of application variables is done in the structure view for the sub-index elements.

4.3.2. C Implementation

There are different possibilities of the C implementation of an object. These possibilities are explained in the following table.

Type	Description
Managed Constant	The value of the object cannot be changed and it is managed by the CoE library.
Managed Variable	The value of the object can be modified at run-time from EtherCAT (according to the access right) and from the application using the function `putObj()`. The memory for this object is allocated by the CoE library.
Application Variable	An variable of the application is used for this object. If the value of the object is changed via EtherCAT the variable is updated automatically. The value of the object can be changed from EtherCAT or from the application using the function `putObj()` or directly using the variable name. If the optimization option "Create Variable" is active, the variable is defined (created) by the EtherCAT® Design Tool. Otherwise an existing variable can be reused.
Application Array	This setting is only valid for 'Array' objects. The object object an C array of the application is used. If the values of the objects are changed via EtherCAT the array elements are updated automatically. The value of the objects can be changed from EtherCAT or from the application using the function `putObj()` or directly using the variable name. Sub index 1 of the object corresponds to the array element 0 if the array in C. This kind of implementation can only be used, if all sub indices (starting at 1) share the same default values, limits and access rights. If the optimization option "Create Variable" is active, the variable is defined (created) by the EtherCAT® Design Tool. Otherwise an existing variable can be reused.

Table 4, C implementation types

Hints for migrating from CANopen or Powerlink Design Tool:
With the CANopen Design Tool only 'Application Variable' resp. 'Application Array' was possible and with the Powerlink Design Tool only 'Managed Constant' or 'Managed Variable'. The EtherCAT Design Tool supports now all implementation types.

At the import of existing projects of the other Design Tools the implementation type is set according to the setting *Options→Import Options→Use Application Variables*.

4.4. Communication variables

As default the implementationtype for communication objects is 'Managed Variable' or 'Managed Constant' but it can be changed to 'Application Variable' as well. For definition of communication variables the same mechanism is possible as described for the application variables. Additionally the necessary data are loaded from the communication object database. That means, the structure of the created variables is already defined and all parameter entries are preset. For EtherCAT® conform devices one has to define at least the objects:

- Device Type (1000_h)
- Identity Object (1018_h)

and more.

The EtherCAT® standard requires these objects.

There are special menus for the creation of communication parameter. These can be reached via the button *Add new Communication Service* in the action menu of the *Communication Segment*.

For each EtherCAT® service e.g. PDOs these menus are prepared. On this menus the user has only to make design decisions. No knowledge about the encoding and the contexts between communication objects is necessary.

4.4.1. Parameterization

For parameterization of communication variables the mask view can be used. With these forms the parameterization of more complex data like PDO parameter and PDO mapping is very easy.

4.5. Generation of source code

When the button *Generate* is pressed the object dictionary implementation in C-code the initialization and configuration files and furthermore an EDS resp. ESI file for each EtherCAT® line (<*ProjectName*>*line*<*lineNo*>**.eds** and if activated a documentation (<*project name*>**.html)** are generated. These files are always consistent and contain the date and the time of generation. Another file **(generate.err)** contains warnings and errors. It is recommended, to have a look to this file by means of *Show* after each generation.

4.6. %-Variables

%-variables can be used in object names and variable names of indices and object names of sub-indices. In the file **objects.c**, in the EDS files and in the documentation and also in the object tree they are replaced by their current values.

Name	Description
%i	number of the index
%s	number of the sub-index
%l	number of the line
%f	number of the service (SSDO, CSDO, RPDO, RPDO-Mapping, TPDO-Mapping, SRDO, SRDO-Mapping) starting at 1
%p	(index - start of segment) starting at 0
%q	(index - start of segment + 1) starting at 1
%u	(index - start of sub segment) starting at 0
%v	(index - start of sub segment + 1) starting at 1
%t	short name of data type

Table 5, %-variables

When using lower case letters for the variables a decimal value is returned. Otherwise a hexadecimal value without leading "0x". Variables that are undefined in the current context (e.g. %s at an index) return an empty string.

Examples für the usage of these %-variables can be found at the SDO or PDO objects in the communication profile.

4.7. {}-Expressions

The {}-expressions allow the usage of %-variables and mathematical operators. Inside of the braces %-variables, constants (decimal/hexadecimal) and the operators + - * and / can be used.
Examples for valid object names with {}-expressions:

- output {%i - 0x100}
- state {%p + 100} at device %l

4.8. Post-Generation command

At *Generation* → *Post-Generation Settings* the post-generation command can be configured. The post-generation command is executed after the generation of the output files. The command may be a shell-script or a batch file, or you may run e.g. 'make all' or start an arbitrary executable file (e.g. the EDS checker or your compiler). The output of the command is written into the file generate.err.

5. Generation of user-specific object descriptions

The Design Tool provides format descriptors for the generation of user-specific object descriptions in ASCII-format for different document types.

The description template is a text in ASCII-Format including format descriptors for object-specific information and has to be stored in file list.conf in the working directory. During the generation of all files the description template is applied to each object. The Design Tool stores the object list in the file userList.txt in the working directory.

5.1. Format descriptors

The Design Tool supports the following format descriptors:

format descriptor	description
%a	access type: RO, WO, RW, RWW, RWR, CONST
%D	refuses write on download: 0 - not valid, 1 - valid
%d	data type according to CiA-309-3 (example: u32)
%e	EDS name of the object index
%F	default value in EDS valid: 0 - not valid, 1 - valid
%g	size in bytes in decimal format (example: 12)
%I	object index in hexadecimal format without prefix (example: 1A00)
%i	object index in decimal format (example: 4096)
%L	line number in hexadecimal format without prefix (example: A)
%l	line number in decimal format (example: 12)
%M	limits in EDS valid: 0 - not valid, 1 - valid
%m	lower (minimum) limit • for numerical objects: in hexadecimal format with prefix "0x" (example: 0xFFFFFFFF) • for string objects: <empty string>
%n	name of the object index in C code
%p	PDO mapping allowed: 0 - not valid, 1 - valid
%O	refuses Read on scan: 0 - not valid, 1 - valid
%R	valid after reset: 0 - not valid, 1 - valid
%S	sub-index in hexadecimal format without prefix (example: A)
%s	sub-index in decimal format (example: 12)
%T	description of the object Take note that the Design Tool can not convert special characters because it does not know the desired document type.

format descriptor	description
%U	upper limit • for numerical objects: in hexadecimal format with prefix "0x" (example: 0xFFFFFFFF) • for string objects: <empty string>
%u	unit (example: 100 ms)
%V	default value • for numerical objects: in hexadecimal format with prefix "0x" (example: 0xFFFFFFFF) • for string objects: without quotation tags (example: Test string)
%v	default value • for numerical objects: in decimal format (example: 1614872592) • for string objects: without quotation tags (example: Test string)
%z	enumeration counter of the object in decimal format, counting starts with 0 (example: 12, i.e. it is the 12th object)

Table 6, format descriptors

5.2. Example for HTML documentation

Each object in the object dictionary is listed with index, sub-index in bold text style and the object description. The following example only refers to object 1000h and 1001h.

list.conf:

```
<p>
  <b> object %Ih/%S </b>: %T
</p>
```

userList.txt:

```
<p>
<b> object 1000h/0 </b>: The device type specifies the kind of device. The lower 16 bit contain the device profile number and the upper 16 bit an additional information.
</p>
<p> <b> object 1001h/0 </b>: The error register is a field of 8 bits, each for a certain error type. If an error occurs the bit has to be set: Bit 0 generic error, Bit 1 current, Bit 2 voltage, Bit 3 temperature, Bit 4 communication error (overrun, error state), Bit 5 device profile specific, Bit 6 reserved, Bit 7 manufacturer specific
</p>
```

indication in the web-browser:

object 1000h/0: The device type specifies the kind of device. The lower 16 bit contain the device profile number and the upper 16 bit an additional information.
object 1001h/0: The error register is a field of 8 bits, each for a certain error type. If an error occurs the bit has to be set: Bit 0 generic error, Bit 1 current, Bit 2 voltage, Bit 3 temperature, Bit 4 communication error (overrun, error state), Bit 5 device profile specific, Bit 6 reserved, Bit 7 manufacturer specific

5.3. Example for Tcl scripts

A list of all objects is created. The entry for each object starts with a comment including the enumeration counter. The enumeration counter is also used as list index for the list objTab. The index, sub-index and the default value are listed for each object. The following example only refers to object 1000h and 1001h.

list.conf:

```
#object %z
set objNum %z
set objTab($objNum,indexHex)      0x%I
set objTab($objNum,subHex)        %S
set objTab($objNum,defValHex)     "%V"
```

userList.txt:

```
#object 0
set objNum 0
set objTab($objNum,indexHex)      0x1000
set objTab($objNum,subHex)        0
set objTab($objNum,defValHex)     "0x00000000"
#object 1
set objNum 1
set objTab($objNum,indexHex)      0x1001
set objTab($objNum,subHex)        0
set objTab($objNum,defValHex)     "0x00"
```

The generated object list can be used after sourcing in a Tcl scripts - especially in the frame for testing in the Console of the CANopen Device Monitor.

6. EtherCAT-Merge PlugIn

EtherCAT-Merge provides functions to visualize and modify differences between different EtherCAT® Design Tool projects. The EtherCAT-Merge extension module is an optional PlugIn which is activated by the license file of the EtherCAT® Design Tool. If a valid license is present, EtherCAT-Merge can be started by the EtherCAT-Merge menu in the menu bar of the EtherCAT® Design Tool.

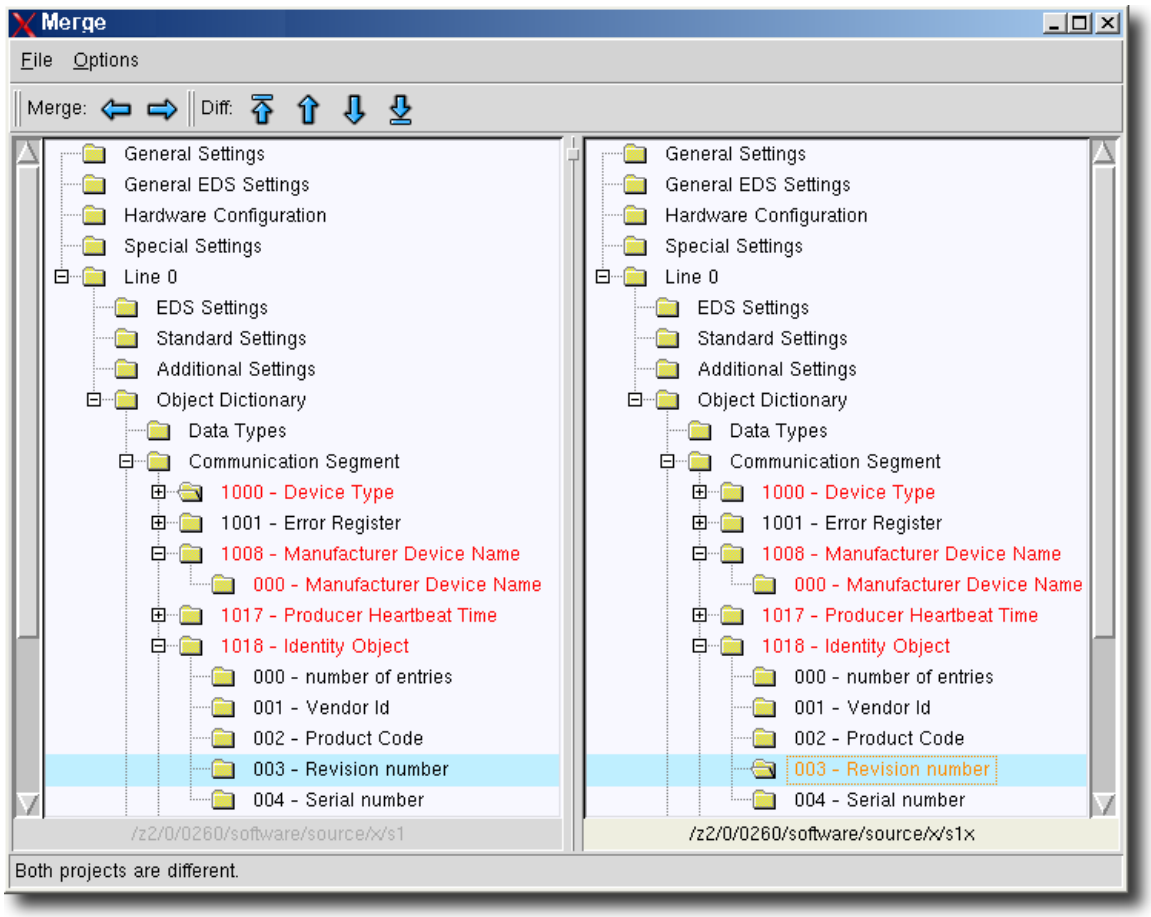


Figure 9, EtherCAT-Merge main window displaying 2 projects

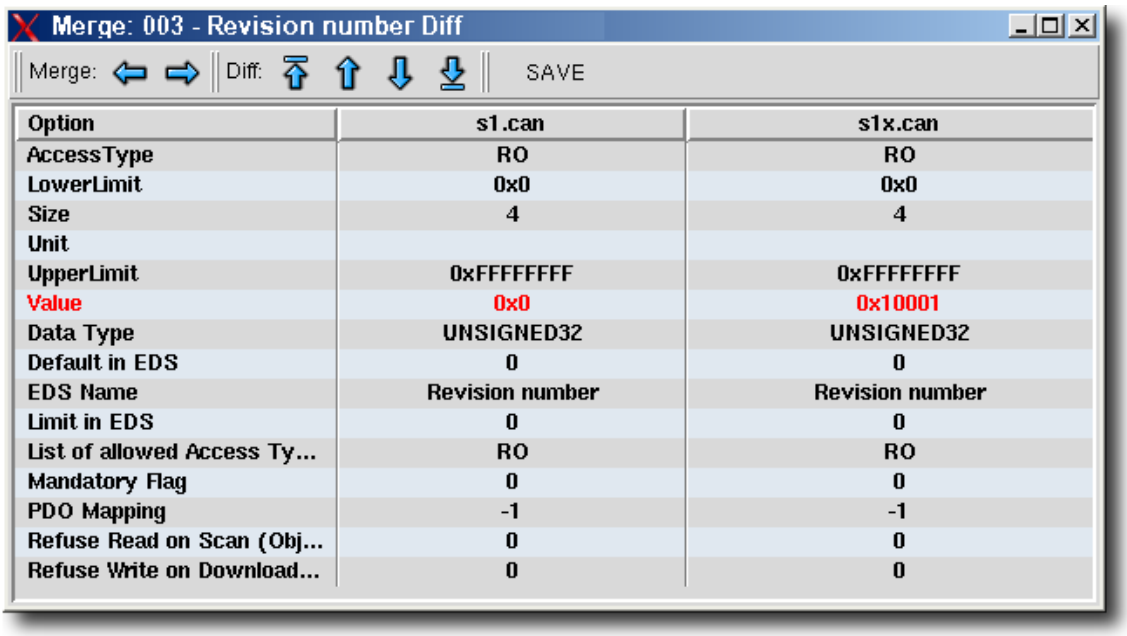
6.1. Project View

The project view shows different settings, sub segments, objects and sub indices with different colors. By using the *Merge* function in the tool bar these elements can be copied from one project into the other one.

Via the menu *File* the modified projects can be saved to disk or imported into the EtherCAT® Design Tool. The menu entries like *Save* resp. *Open* refer to the active project tree. Via *Generate Diff Report* an overview about the differences between the projects can be generated. This diff report is an XML file containing all differences.

Via *Options* several settings can be configured. These include the attributes to be compared or merged and further options.

6.2. Detail View



Option	s1.can	s1x.can
AccessType	RO	RO
LowerLimit	0x0	0x0
Size	4	4
Unit		
UpperLimit	0xFFFFFFFF	0xFFFFFFFF
Value	0x0	0x10001
Data Type	UNSIGNED32	UNSIGNED32
Default in EDS	0	0
EDS Name	Revision number	Revision number
Limit in EDS	0	0
List of allowed Access Ty...	RO	RO
Mandatory Flag	0	0
PDO Mapping	-1	-1
Refuse Read on Scan (Obj...	0	0
Refuse Write on Download...	0	0

Figure 10, EtherCAT-Merge diff window displaying differences of 2 sub indices

The detail view displays differences of global settings, indices and sub indices. Attributes of indices and sub indices can be modified directly within this view. Modifications have to be confirmed by the button *SAVE* in the tool bar. A plausibility check is performed when saving these settings.

7. CSV-Import PlugIn

7.1. Usage

With the CVS Import PlugIn objects of the object dictionary can be imported from CSV files. Thus it is possible to export object definitions from other sources (e.g. data bases) as a CSV file and import it into the EtherCAT® Design Tool.

The format of the CSV file can be specified using an *Input Description Specifier*. It allows to select only some columns of a csv file. Additionally, an object offset can be speficied for the import.

The CSV Import extension module is an optional PlugIn which is activated by the license file of the EtherCAT® Design Tool. If a valid license is present, CSV Import can be started by the CSV Import menu in the menu bar of the EtherCAT® Design Tool.

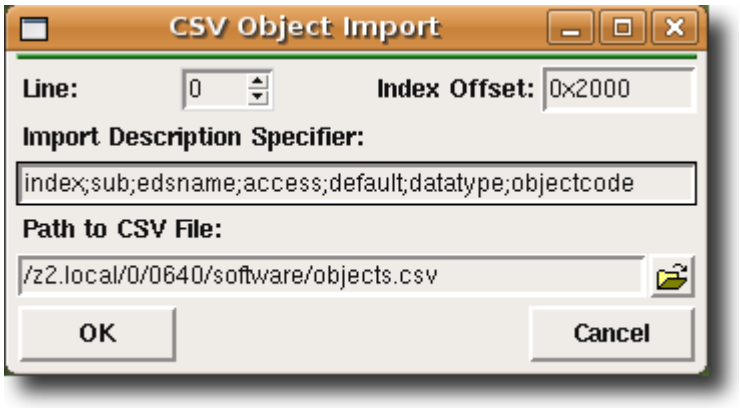


Figure 11, CVS-Import configuration mask

The following table describes all tokens that can be used for the Input Description Specifier and their value range for the corresponding column in the CSV file. Commas, semicolons or tab stops can be used as separator between the tokens, but only one of them.

Element	Value range
index	index in the range between 0x2000 and 0x9FFF
sub	sub index in the range between 0 and 254
edsname	arbitrary string
varname	valid C variable name
access	RO, RW, WO, CONST, RWR, RWW or as lower case letters
unit	arbitrary string
min,max,default	numbers using C notation
datatype	EtherCAT® datatype as decimal number (see object dictionary)
objectcode	VARIABLE (default), ARRAY or SUB
desc	arbitrary string only for VARIABLE or ARRAY
createvar	flag if the c-variable shall be created (0 or 1)

Element	Value range
pdomapping	flag if it can be mapped into a PDO (0 or 1)

7.2. Examples

This examples shows a standard configuration of manufacturer specific objects.

Input Description Specifier:

```
index,sub,varname,edsname,unit,access,min,max,default,datatype, \
objectcode,createvar,pdomapping
```

CSV File:

```
0x3000,0,man_eins,EDSName_1,,ro,0,0xff,0xF0,5,VARIABLE,1,0
0x3001,0,man_zwei,Variable_2,,ro,0,0xff,0xF0,5,VARIABLE,1,0
0x3002,0,man_drei,Ohne_Create_Var,,ro,0,0xff,0xF0,5,VARIABLE,0,1
0x4000,,min_array,Lufthupen,,rw,,,,6,ARRAY,0,0
0x4000,1,,Lufthupe_1,,wo,0,0xf1,0x01,6,SUB,1,1
0x4000,2,,Lufthupe_2,,ro,0,0xf2,0x02,6,SUB,1,1
0x4000,3,,Lufthupe_3,,rwr,0,0xf3,0x03,6,SUB,1,1
```

The next example shows how to ignore some columns from the CSV file.

Input Description Specifier:

```
;;;;index;;;varname;;;access;default;datatype;objectcode;edsname
```

CSV File:

```
whatever;;ign;;0x2001;0;0;test_1;;;ro;0;6;VARIABLE;Number of Inputs
whatever;;ign;;0x2002;0;0;test_2;;;ro;0;6;VARIABLE;Number of Outputs
whatever;;ign;;0x2003;0;0;test_3;;;ro;0;6;VARIABLE;Number of Variables
```

8. Different versions

8.1. Standard version

The standard version provides the functions as described herein.

8.2. Light version

In the light version the number of objects is limited to 15 per line. Using the light version it is not possible to generate output files, if a line consists of more than 15 objects.

8.2.1. Limitations

If the number of objects is below 15, all output files of the EtherCAT® Design Tool are generated. If the limit is exceeded, the 'Light' version is only able to generate the library configuration file **ecat_conf.h.**

8.2.2. Usage

If no future use of the project files in the standard version of the EtherCAT® Design Tool is intended, only the following masks and input fields have to be completed:

- General Settings
- Hardware Configuration

To configure the EtherCAT® Library according to the used EtherCAT® services the following procedure is recommended:

- Create the desired lines
- In every line the communication segment has to be filled completely.

When the configuration is complete the file **ecat_conf.h** can be created by *Generate all Files*. The project file of EtherCAT® Design Tool light has to be saved too, because it is not possible to import the Library configuration from a **ecat_conf.h**.
The project file can be reused in the standard version of the EtherCAT® Design Tool.

Appendix 1 — Abbreviations

CAN	Controller Area Network
CAL	CAN Application Layer (CANopen base)
CiA	CAN in Automation international users and manufacturers group e.V.
COB	Communication Object (CAN Message)
COB-ID	Communication Object Identifier
DDE	Device Description Entry
EMCY	Emergency Object
EPL	Ethernet POWERLINK
EPSG	Ethernet POWERLINK Standardization Group
ESI	EtherCAT Slave Information XML device description for EtherCAT slaves
ETG	EtherCAT Technology Group
NMT	Network Management
PDO	Process Data Objects, they are messages in a unconfirmed service. They are used for the transfer of real-time data to and from the device.
RPDO	Receive PDO
SDO	Service Data Objects, they are messages in a confirmed service. They are used for the access to entries of the object dictionary.
CSDO	Client SDO
SSDO	Server SDO
SYNC	Sychronization Object
TIME	Time Stamp Object
TPDO	Transmit PDO
XDD	XML Device Description - device description files for POWERLINK or CANopen
XML	eXtensible Markup Language